# WOON TAN KAN & ORS. v ASIAN RARE EARTH SDN. BHD.

**HIGH COURT MALAYA, IPOH**
**PEH SWEE CHIN SCJ**
**[CIVIL SUIT NO. 185 OF 1985]**
**11 JULY 1992**

**[1992] 3 CLJ 786 (Rep) [1992] 4 CLJ 2299**

***CIVIL PROCEDURE:*** *Quia timet injunction - Damage substantial and imminent - When should be given.*

***TORT:*** *Nuisance - Private nuisance - Substantial interference with the enjoyment of land - Proof of actual damage not required - Presumption of damage - Negligence not an essential element - Injunction proper remedy for nuisance - Escape of radon gases constitute danger to health - Biological effect of ionising radiation - Damage to ovum and sperm cells - Long term effects - Cancer, congenital defects, mental retardation - Damage to DNA in the human cell - Balancing the interest of the parties - Whether the licence issued under the Atomic Licensing Act 1984 entitled the defendants to commit the nuisance.*

***TORT:*** *Negligence - Whether actual damage must co-exist with negligence to give rise to cause of action.*

***TORT:*** *Rule in Rylands v. Fletcher - Collection and storage of monazite in defendants' plant - Escape of radon gas - Damage essential to constitute cause of action - Whether Rule applied.*

***WORDS AND PHRASES:*** *Meaning of "Imminent."*

The plaintiffs residents of Bukit Merah village, sued the defendants, principally for an injunction to restrain the defendant company (ARE) from operating and continuing to operate its factory, alleging that its activities produced dangerous radioactive gases harmful to Bukit Merah residents.

They based their claim in negligence, the rule in *Rylands v. Fletcher*, and nuisance, and sought various declarations, damages and injunctions.

The defendant's plant, situated near the village, commenced operation in 1982 under the authority of the Ministry of Health and the Radioactive Substances Act 1974, authorising the handling of radioactive materials. The manufacturing licence was obtained from the Ministry of Trade and Industry. Under the Atomic Energy Licensing Act 1984, the Atomic Energy Licensing Board was responsible for radiation protection standards, licensing, inspecting and enforcing. The ARE plant was closed on 5 November 1985 under the orders of the Atomic Energy Licensing Board and resumed operations again on 2 February 1987 after obtaining approvals

from the said board. The plant processed monazite, which contains six (6) per cent of thorium and thorium is radioactive and such thorium is doubled after the monazite was processed by the defendant's plant. Monazite also contained other radioactive substances such as uranium, and radium, though in smaller quantities. The processing of monazite has as its purpose the obtaining of "rare earths" chemical compounds of great utility.

The by-products of processing monazite are thorium hydroxide which is radioactive and lead. When thorium decays, it produces *inter alia*, thoron gas (radon 220) and with uranium, it is radon gas (radon 222). The thorium, radon and thoron and the products into which they decay all give off radiations of the alpha or gamma variety, which could cause harmful biological effect on human cells.

Voluminous evidence was adduced by the parties, including the testimony of expert witnesses, which was often conflicting and contradictory.

The plaintiffs claimed that radiation and dangerous gases escaped from the plant to the area where they were living, causing serious biological damages including cancer.

The defendants denied the escape of radiation and dangerous gases and claimed that their activities were safe and did not enhance the background radiation in the area. The presence of radiation was attributed to natural phenomena. The defendants denied that their activities caused increased incidence of leukaemia, miscarriages, pre-natal and post-natal deaths and child illnesses and lead in blood among the residents of Bukit Merah.

ARE also contended that it was licensed to handle and store radioactive substances by virtue of licences issued under the Atomic Energy Licensing Act 1984.

**Held:**

**[1]** The processing of monazite at the defendants' factory produced dangerous radioactive materials, including radon gases which are dangerous to health and would cause very serious injuries in the long term. The radon gases that escaped inevitably from the operation of the plant in its simple and open factory did enhance the background radiation to an unacceptable level. The production process failed to trap any of these radioactive radon gases.

**[2]** The radiation measured by the plaintiffs' expert witnesses were accepted as more probable on a balance of probabilities as the radiation level readings of the defence expert witness did not make any sense and defied common sense.

**[3]** Between May 1982 and November 1985 the waste of the ARE's processing including thorium hydroxide, a by-product, was not stored or kept away in a sufficiently safe manner. However, the plaintiffs have failed to prove on a balance of probabilities that the defendants' had not exercised a sufficient amount of care towards them in regard to the operation of are after 5 February 1987. As there was no evidence of actual loss or damage which were directly attributed to the negligence of ARE before 1985, the claim based on negligence was dismissed as actual damage must co-exist with negligence.

**[4]** The claim based on rule in *Rylands v. Fletcher* also did not succeed, as the rule like other torts such as negligence, cannot be maintained when damage has not been suffered, even though the radon gases which were dangerous to health did escape from ARE's plant and monazite had been brought, collected and kept there at the ARE's premises for processing.

**[5]** However, the plaintiffs were entitled to a *quia timet* injunction, which is an exception to the above rule. In *quia timet* injunction no actual damage need to be proved and the damage need not be "imminent" as understood in everyday usage. An action can be filed and will be entertained by the Court for this type of injunction before actual damage had happened, that is, before a complete cause of action was completed. All that was required was that there should be some practical certainty of substantial damage and that it was imminent.

**[6]** In the instant case, there was a high probability that the dangerous radon gases that escaped into the atmosphere would cause very serious injuries to large number of people and the biological damage to human cells was irreparable. Such injuries would only be palpable and visible to the doctors in the future. The injuries, though not imminent, in the ordinary sense of the word, but the magnitude of such injuries involving a large number of people was mind-boggling. The terms of the injunction, *inter alia*, were:

(a) That the defendants were not entitled to operate their factory and keep their toxic and radioactive waste upon its land at Bukit Merah.

(b) That the defendants be restrained from operating the factory, producing, storing and keeping its toxic and radioactive waste upon its said land. Their activities caused the escape of radioactive gases and rays into the neighbouring land occupied by the plaintiffs.

(c) That the defendants remove all the toxic waste and radioactive waste as soon as possible to their permanent storage facility at Belanja, Perak.

(d) That a stay of injunction be granted for 14 days to enable the defendants to comply with the injunctions.

**[7]** The plaintiffs had succeeded in establishing the tort of private nuisance. In an action for private nuisance, proof of actual damage, physical or financial or personal injury was not required. Negligence was also not an essential element in nuisance (*Wagon Mound No. 2* [1967]). The expert evidence showed that the level of radioactive gases in Bukit Merah had increased considerably thereby posing long-term health hazards to the residents. Thus there was a substantial interference with the comfort of the plaintiffs in the enjoyment of their land and as such they reasonably constituted an annoyance to the plaintiffs. Damage is presumed once the nuisance was established, that is, with regard to the substantial interference with enjoyment of their land, *viz.* their health was being affected harmfully, insidiously, significantly or to substantial degree. Upon such proof of annoyance, an injunction may be suitably considered though no pecuniary compensation may be awarded.

**[8]** Although the ARE plant had been situated in an industrial area, and therefore the character of the neighbourhood was relevant, the release of dangerous radioactive gases endangered the lives

of the people and upon balancing of the interests of ARE and those of the plaintiffs, the interests of the plaintiffs prevailed.

**[9]** The licence granted to operate the factory under the Atomic Energy Licensing Act 1984 could not entitle the defendants to commit nuisance when such lawful acts were not confined within the defendant's land. Further the defendant's factory was not performing a statutory duty but was only granted licence to manufacture the rare earth commercially.

***[Application for injunctions allowed.]***

**Cases referred to:**

*Rylands v. Fletcher* ***(not foll)***

*Suffolk River Catchman Board v. Kent [1941] AC 74* ***(foll)***

*Read v. Lyons [1947] AC 156* ***(refd)***

*White v. Mellin [1845] AC 154* ***(refd)***

*Earl of Ripon v. Hobart [1834] 3 My & K 169* ***(refd)***

*Hooper v. Roger [1975] Ch D 43* ***(foll)***

*Rapier v. London Tramways [1893] 2 Ch 588* ***(refd)***

*Crump v. Lambert [1807] LR 3 Eq 409* ***(refd)***

*St. Helans Smelting Co. v. Topping [1805] 11 HLC 642* ***(refd)***

*Newman v. Real Estate Debenture Co. [1940] 1 All ER 131* ***(refd)***

*Wagon Mound No. 2 [1967] 1 AC 643* ***(refd)***

*Barnford v. Turnley [1862] 3 B & S 62* ***(refd)***

*Miller v. Jackson [1977] QB 966* ***(refd)***

*Hooi Wee Thim v. Pacific Tin Consolidated Corp. [1966] 2 MLJ 240* ***(refd)***

*Green v. Chelsea Waterworks Co. [1894] 70 LT 547* ***(foll)***

*Longhurst v. Metropolitan Water Board [1948] 2 All ER 834* ***(foll)***

*Charing Cross Electricity Co. v. Hydraulic Power Co. [1914] 3 KB 772* ***(refd)***

**Counsel:**

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*For the defendant - P.S. Gill (C.P. Mehendran with him); M/s. Cheang Lee & Ong*

**JUDGMENT**

**Peh Swee Chin SCJ:**

This case, in a nutshell, is one of alleged but denied radioactivity and has naturally and understandably generated a great deal of apprehensions among the plaintiffs and the residents of Bukit Merah village.

Voluminous evidence has been adduced by both sides and such evidence would seem at times to neutralize each other; submissions or extended submissions by learned Counsel, in writing (as opposed to the usual oral submissions) were finally, as regards the last of which, received on 20 November 1990; the presence of such amount of scientific or technical evidence which could be only intelligible to scientists or advanced students of physics has been such that it has taken quite a while to be digested - and these interwoven with many deadlined and daily chores of judicial nature have all contributed to delay for this judgment, thus prolonging the anxieties for both sides. I apologise for such delay unreservedly for enhanced efforts ought to have eliminated such delay.

The plaintiffs and the fellow residents of Bukit Merah for whom they have sued also have been at all material times and still are residents of Bukit Merah village which is across the Jalan Lahat from a factory of defendant either about 400 yards or about 1,500 yards away. The factory of the defendant, after its completion, started operating in May 1982. It processes monazite, which is itself obtained from amang. Amang is itself a by-product of tin mining. The defendant has maintained all along that its factory is a chemical factory and not a nuclear one as alleged by the plaintiffs.

The important thing to bear in mind is that I am bound by the pleadings filed by both sides, representing the battle lines that have been drawn. The plaintiffs sued in negligence, rule in *Rylands v. Fletcher* and nuisance and they have asked for declarations, damages, and principally injunctions to restrain the defendant from operating or continuing to operate its factory etc. I give judgment according to these lines.

I will now set out for compactness, the salient features of the evidence of both sides pertaining to the issues of negligence, rule in *Rylands v. Fletcher* and nuisance, but evidence not set out below has been considered and taken in account.

As regards the evidence of the plaintiffs, plaintiff No. 4 (PW1) gave evidence about the factory having started operating in July 1982 about 400 yards from his house. He saw waste from the defendant's factory in lumps, dumped on the defendant's land near the factory. The waste was

also in plastic bags. The waste was on defendant's land. There were also two ponds in the said land of the defendant near its plant. Later on, the ponds were apparently filled up and a store was built there. There was no fence on the defendant's land. The ponds were filled up since filing the action in March 1985. The waste was taken out of the factory by workers using tractors and thrown all over the ground. He had read it in the newspapers that the factory's by-product was giving off radiation which caused cancer. He agreed that in October 1985, PW2 was the owner of a timber company operating about 100 yards from the defendant, beyond which were a charcoal kiln, a vegetable (garden) plot, and some level ground used as playing ground by boys in the evening. He saw substances being dumped there on the dump site of the defendant's land. The substances were mostly whitish, some were brown or blue. Tractors and sometimes lorries were used. He and others formed a Bukit Merah Action Committee of Anti-Radiation of which he was the secretary.

Three experts were employed to assist them. The first was the English expert Dr. William Cornell, the second, Dr. Radford from USA and third, Professor Ichikawa from Japan. The three experts all visited the defendant's place. Professor Ichikawa took measurements of radiation in December 1984. Even in December 1984, waste from the defendant's factory was still kept in loose form and plastic bags. Red drums were seen there - old drums and damaged ones too. Photographs were taken and identified in Court from the substances dumped there and the drums used. On 14 October 1985, an injunction was obtained. The injunction is set out below for ease of reference:

Upon the application of the plaintiffs by summons in chambers dated 27 March 1985 (encl. 5).

And upon reading the affidavits and exhibits therein of Chong Kim Choy filed on 27 March 1985, Loh Sin Yau filed on 13 September 1985, Mathews George filed on 13 September 1985, and Meenakshi Raman filed on 13 September 1985 and 4 October 1985 and the affidavits and exhibits therein of T. Shigenobu filed on 8 June 1985.

And upon hearing Mr. G.S. Nijar assisted by Mr. Mohideen Abdul Kader, Ms. R. Meenakshi and Ms. K. Rajeswari, Counsel for the plaintiffs and Mr. V.S. Viswanathan assisted by Mr. Selvanathan, Counsel for the defendants.

And the plaintiffs by their Counsel undertaking to abide by any order this Court may make as to damages in case this Court shall hereafter be of opinion that the defendants shall have sustained any by reason of this order which the plaintiffs ought to pay.

This Court orders that the defendants whether by themselves or by their servants or agents or any of them howsoever be restrained until after judgment in this action or until further order from producing, storing and keeping the radioactive wastes upon their land at 4½ miles, Lahat Road, Lahat, Perak and adjoining lands in such a manner as to cause the escape of radioactive gases and rays.

And it is further ordered and directed that the defendants whether by themselves or by their servants or agents or any of them howsoever to forthwith:

(1) Establish an above-ground temporary enclosed storage building for the thorium hydroxide waste;

(2) Ensure that the type of containers (bags or drums), for the waste for temporary storage is the same, as that chosen for permanent storage, to avoid the need for repacking;

(3) Store the waste in the temporary storage building above the ground, high enough to protect it from possible flooding;

(4) Establish and maintain an exclusion zone of 10 meters with controlled access, around the temporary storage building;

(5) Equip the temporary storage with a ventilation before entry of operating personnel.

And it is further ordered and directed that the defendants whether by themselves or by their servants or agents or any of them howsoever for the operation of the plant and the temporary waste storage facility:

(1) Ensure that the building, transportation and deposition of the waste be suspended during severe rain and windstorms;

(2) That the containers already filled and awaiting transportation to the storage facility are covered and protected from possible flooding;

(3) That before transportation to the storage area, the full containers are checked for damage, surface contaminations, and if necessary, decontaminated;

(4) That the lead-lined box proposed to be used for transportation of the waste is washed down frequently and that the wash water be collected and returned to the process, or properly treated;

(5) That after any accidental spill of the waste in the transport box, and periodically otherwise, the box be checked for surface contamination and if necessary, decontaminated;

(6) Have strict housekeeping procedures approved by competent authority which are complied with during the whole operation, so as to keep radiation exposures of the workers and of the public as low as reasonably achievable, social and economic factors taken into account;

(7) Ensure that the services of a qualified radiation protection officer is secured and who is given clear responsibility for, and authority in, enforcing sound radiation protection practices in the operation, and for the necessary monitoring.

It helps matters for Court to mention here in advance that from the evidence, the interlocutory injunction issued by the Court at the instance of the plaintiffs was served on 14 October 1985 on DW1, the general manager of Asian Rare Earth. The operation of ARE plant was stopped on 5 November 1985, and according to DW1, because ARE was formally ordered by the Atomic Energy Licensing Board to stop. It resumed operation on 2 February 1987 after licences were

issued in 13 January 1987 by the said board for handling and storing radioactive materials. Operation was resumed despite the injunction because Asian Rare Earth contended that the injunction (granted by a previous Judge of Ipoh) was only a qualified injunction dependent on certain guidelines to be complied with. Such contention was challenged. Contempt proceedings were contemplated and filed and have never been heard because of commencement and continuance of hearing of this case up to now.

By October 1987, a chain-link fence which had been in place for some time was demolished to make way for a brick wall. Four buildings were built towards the end of 1987. He said the readings from measurement of radiation levels were dangerous. He said that the Minister of Health gave a licence to the defendant under Radioactive Substances Act. Professor Ichikawa took readings on top of the drums.

PW3, a lorry transport company owner gave evidence to say that in 1983, he provided them transport for the defendant company (hereinafter called the ARE). He employed six lorries to transport thorium and other rubbish on to a site behind ARE's factory where most of the material was dumped into one pond. Some of the substances, were in lumps, and some in plastic bags. He was shown the same photos referred to earlier and he identified them. It was he who did the actual dumping. The substances were also put into drums by him and his men. ARE had not given specific instructions as to where to dump them. The people in the ARE wrote "transport of thorium cake" or "TCP" on his bills. He identified some bills with the words "thorium disposal" written by staff of ARE. He said a tractor was used to push the thorium cakes into the pond.

He had his lorries washed within the factory and the sewage flowed into a stream nearby. He was told to buy the cheapest drums, broken ones would do. When people demonstrated against ARE, he used the tractor (the backhole tractor) to dig up the materials and put them in the drums. He managed only to dig up a part of such materials as his workers refused to carry on the work. He had in fact dumped the materials outside the dump site of the ARE, in three parts of Ipoh city area, one at Menglembu (about a mile from the ARE), the other at his uncle's vegetable farm and some at a rubbish dump. He had done the transporting for ARE from February 1983 up to April 1984. He had disputes with ARE over the bills.

It appears to the Court that the processing of monazite, has as its purpose the obtaining of "rare earths" chemical compounds of fairly great utility and the defendant by its defence admits that the by-product from such processing has the following typical composition:

Undecomposed residue ... 18 - 23%

Rare earth hydroxide ... 7 - 9%

Barium sulphate around ... 2%

Lead sulphate around ... 1%

Radium sulphate ... trace

Thorium hydroxide ... 13 - 16%

Uranium hydroxide around ... 0.6%

Water ... 54%

The mention of the said composition was rendered necessary as Dr. Rosarie Bertell, an expert called by the plaintiffs had referred to the elements mentioned in the said composition.

Dr. Bertell, a physicist said she also had taught physics in university, had degrees of B.A. M.A. Ph.D. - the Ph.D for application of mathematics to biological sciences, and her master's degree was, according to her, equivalent to biology and biochemistry at Ph.D level.

She said thorium or thorium hydroxide was radioactive. Being radioactive, thorium decayed and the decayed products including radium, were harmful because there would be periodical explosions with the consequent release of energy. Such bursts of energy could damage cells and tissues when inside the human body. The thorium entered the body through breathing, open wounds and fingers from gas or dust. Thorium decayed into radium to produce another radioactive substance called radon 222. Such decaying of thorium took place in nature naturally but such decaying was concentrated at ARE plant. Radon, she said further decayed into radioactive lead, radioactive bismuth and radioactive polonium. The lead was easier to look for. Lead was known to stay in bones in a body for an average of 10 years. Its effect, among other things would depress the count of the white cells of the blood. The white cells, produced in bone marrow fought infection and acted as scavengers for the body. Radon damaged the white blood cells and lowered resistance to infection. The radioactive lead had periodical burst of energy which damaged the cells. Radon was radon gas. There was an information base in each cell called DNA. If DNA was damaged by this burst of energy, it would produce similarly damaged cells and it would be several years for sufficient number of these damaged cells to be felt. Ovum cells showed it faster. If DNA of ovum or sperm cells was damaged, such damage would be transmitted to 50% of the offspring, where some part of the baby would be affected e.g. the brain. The damage was congenital and a baby would be born blind or deaf. ARE, she said, produced dust particles of radon as well as radon gas. The dust particles contained thorium hydroxide, uranium, radon and radioactive lead. Monazite, the material processed by ARE contained uranium too but it had a high content of thorium.

If any of these (radioactive) materials decayed in rocky formation underground, the decayed products including radon gas remained underground but any milling or crushing of rocks would give away radioactive dust which reached human body easily and so radon gas was more easily breathed in. There was no level of exposure to them that could not cause damage. When she visited ARE in April 1987, she had an instrument for measuring the burst of energy released. Her instrument recorded 16 counts per minute of such energy outburst in Ipoh (city) equal to 70 millirems per year. This was normal limit due to natural background radiation. At the gate of ARE, the reading equalled 192 millirems per year. Exposure to radiation was cumulative. The processed monazite recorded 5037 millirems per year. The legal limit (maximum) in Malaysia as recommended by Atomic Energy Licensing Board in Malaysia of exposure to radiation was 100 millirems per year plus 75 millirems of background radiation and in the United States it was 25

millirems per year also over 75 millirems background. She found for example, levels of 25 times higher at the place near the side wall of the temporary dump site or temporary waste storage facility and the place near the drain pipe from the site. Thorium inside the drums at ARE have a life of 14 billion years and its decayed products lasted forever. The waste should be repackaged after 35 years.

Lead was one of the by-products together with thorium produced by ARE. They decided to test for lead in children of Bukit Merah as a marker to see if the children were exposed to radiation. She came to the conclusion that lead was in their bodies (60 children tested), the exposure to lead would be about six times that of an average person. She was in Ipoh for one day during which she visited the dump site, the proposed (permanent) dump site and the vicinity of ARE. She had eliminated the factors such as petrol and paint. The blood test for lead was a matter for which she was cross-examined thoroughly, for example for not having a "control" point for comparison purpose.

The next witness was Dr. Jayabalan, a private medical practitioner, formerly in the medical service of the Government. Speaking of the children of Bukit Merah tested by him, as compared with those in Carey Island he tested, the children in Bukit Merah had more illnesses than the other group of children despite superior nutrition. Dr. Jayabalan also talked of pre-natal and neo-natal deaths with the former referring to babies that died within one week of delivery and the latter referring to deaths in babies within one week to one month after delivery and miscarriages also. He took 108 samples of mothers of the age of 30 or below from Bukit Merah between 1982 to 1986. Fifteen of such mothers experienced unexplained miscarriages, pre-natal and neo-natal deaths of babies, representing 13.8% as compared with 2.5% of Malaysian average from the extract of statistics. He described the percentage of Bukit Merah alarming. He said it was a very consistent possibility that radiation had caused the deaths and though he was not an expert in genetics, and this was the first time he had done this kind of survey before. (He was extensively cross-examined on the methods he adopted).

Two mothers (PW6 and PW7 respectively) living at Bukit Merah who both had miscarriages gave evidence about the miscarriages. One of the witnesses, it emerged, had her own mother having the same experience.

PW8, Dr. Professor Edward Radford, a very eminent physician, with his area of expertise being in environmental medicine about exposure to various environmental agents (including radiation) specializing in genetics. The list of his qualification is very long.

In 1984, Professor Radford said he went to inspect the ARE factory from outside and the dump site. He saw a pond with waste in it. He explained that many constituents of monazite were radioactive and because of the process of separation, the concentration of radioactive materials increased so that there would be more radioactive materials than before the separation. The radioactive materials were in the monazite itself, thorium 232 and uranium 238. They would break into various elements in a chain of radiation (they would decay, being unstable) and such elements were themselves radioactive giving off different kinds of radiation *viz*. alpha and gamma radiations. Gamma radiation, unlike alpha radiation, could penetrate bodies and walls. Radiation, while inside the body, released its energy and it produced ionization in which

electrons were removed from the atoms. The electrons thus released produced chemical change in the body for example electrons could interact with water molecules to form active chemicals which could react, with the cells in the body (i.e. affecting the cells in the body). Each cell contained DNA, the genetic code which advised the cell as to how to reproduce itself. When the products of ionization reacted with DNA code the genetic information in the cells was possibly transformed. If that DNA happened to come from an ovum or sperm, the genetic code was changed and such child would have genetic abnormality.

Another fact was the change in the genetic code predisposed the cells to late production of cancer for the child. The effect might be also to slow growth or lead to mental retardation. Alpha radiation could not penetrate tissues deeply, but when penetrated, it produced 20 or more times changes in the body than gamma radiation which released less energy by comparison. This alpha radiation could not penetrate the thickness of the skin. The decayed products of radioactive materials that gave alpha radiation, for example, could however get into the body through swallowing e.g. thorium and uranium both changed and decayed, producing two gases one of which was radon. If radon was in a thorium cake, it would escape into the air. The two gases were radon 222, and radon 220, the latter was also known as thoron. Thorium had a life of 14 billion years (practically forever) and thoron had half of its life (7 billion years). When thoron decayed, the decayed products could attack the lung tissues causing lung cancer.

He commented the ARE had no concept of the risk of the radioactive materials; was casual and had no concern for which it did. The factory building was an open simple building with penetration hazard of exposure to gamma radiation and radon. Even in small doses, the changes effected were the same, and relationship between doses and their effect was a straight line, that is if one got radiation, one got the effect immediately, with no threshold (doses). He said he had pointed out in 1984 that some permanent location for dumping was needed badly for the ARE and the people. Four years later, no such facility was under construction. The life of thorium was 14 billion years and about the life of drums, he wondered.

In cross-examination, he agreed that he was at the site of ARE for 2 or 3 hours, he could not go inside the factory though he attempted to do so. He did not know the measures taken for radiological protection. He said lead could be used as a tracer for thorium exposure when lead was associated with thorium. He said thorium in the body could be traced but the process for analysis was expensive.

Another expert called by the plaintiffs was Professor Ichikawa of the Genetics Division of the Faculty of Science of Saitama University. He conducted measurements in the vicinity of ARE for which he used two measuring instruments, one was dose rate meter and the other, thermoluminescence documentater (which should read "dosimeter"), or "TLD" for short. The first time he conducted the measurement was from 28 December 1984 to 31 December 1984 using TLDs for 50 points and left some other TLDs in the University as a control. He produced a summary of the results. The readings were extremely high. The lowest reading was 7 times higher than 100 millirems per year (hereinafter mr/py) and the highest was 48 times higher than 100 mr/py, all in the vicinity of ARE factory. Papan town had readings of 20 to 80 mr/py. The second time he took measurements was from 25 October 1986 to 28 October 1986 (when the ARE plant had stopped its operation before resuming it later).

He used 65 to 70 TLDs and planted them in the vicinity of the ARE plant. He produced the results of the measurement. Learned defence Counsel informed Court on being asked, that the factory was still closed in 1986. Most of the readings were found to have gone down on the second occasion. He said the readings were still high. This time there was a store built there which he called temporary thorium waste storage site with thick walls. The readings ranged from 1730 outside the building of thick walls. The readings had decreased by about ½. The highest was 24 times higher than the 100 mr/py. He examined an abandoned truck at Menglembu in which he could see flakes of thorium waste on the floor chassis and tyres with lowest readings 500 mr/py and higher reading of 2,700 to 3,600 mr/py. He also saw an open field - the "dump" of the ARE factory (as well as) a grazing ground where the readings on conversion would be 5000 millirems and 72,000 millirems, that is 50 and 720 times respectively of the level of 100 mr/py fixed by ICRP (International Commission for Radiation Protection).

Professor Ichikiwa said he had published a lot of papers in connection with plants in the field of radiation and he said that knowledge he obtained from plant cells could apply to human cells and both human and plant cells had DNA. DNA and protein formed chromosomes the structure of which was same for both human and plants, and that it was easier to observe the effect of radiation on plants. Each stamen in a plant contained hair which contained linear chains of cells which could be easily examined under a microscope without being concealed by chemicals. He said plant materials could detect doses even smaller than the permitted ones when they were exposed to ionizing. First, there was response from genetic level; then secondly from the chromosome level; and thirdly from the cellular level; fourthly from the tissue level; fifthly from the individual level; sixthly from the population level and the seventh level from ecosystem level. One could see the breakdown of DNA level and this could destroy the genetic code. If destroyed a new protein with different biological reaction causing mutation, and genetic information was altered, killing the cells of plants or prohibiting their cell division or delaying cell division, or lengthening cell division causing "cancer" of tissues. The growth of a plant might be delayed or the plant might be killed.

Trees died, till new ones appeared, and they had not been seen before. There was no threshold level; if there was a dose there was an impact. He carried out experiments on very low levels of radiation. He said to the effect that background radiation was equal to natural background radiation given by cosmic rays and also from the earth because of presence of (radioactive) minerals and if radiation was from activities of mankind it was not natural. He said he obtained his master's degree and also doctorate in agriculture science majoring in genetics, radiation effect on chromosomes, etc. The plant cells had similar radioactive sensitivity as human cells, almost equal sensitiveness.

In 1971 the result of his experiment was published about a plant being studied and its scientific name was Tradescantia and data were obtained. He asked if he could have 10,000 cells in each flower for obtaining the data, could he have 10,000 mice, for example for the data? His data had been approved many times, by those including Dr. Sparrow, Dr. Dosier, Dr. Peter Lowes. He said in the case of a nuclear power station of Japan's Atomic Energy Company, his evidence was accepted and the plaintiffs had asked the Government to cancel a licence granted by it. The plaintiff succeeded, and the case was pending appeal in the Appeal Court. Shown a passage in D37, Report No. 89 of Natural Council of Radiation Protection, he agreed that it was very

difficult to identify internally deposited radioactive materials. He was shown two passages at p. 370 from *Health Risks of Radon* and Other *Internally Deposited Alpha Emittens,* **Beir IV** published by National Research Council. (Two passages at p. 370 were marked as Exh. D37).

He agreed with D37. He explained there was a difference between spontaneous mutation and radiation - induced mutation. Coming from Japan, he said he had taken precaution with his TLDs when passing the X-ray examination point. He agreed they were exposed to cosmic rays while flying more than 30 thousand ft. high but he disagreed that a passenger in a plane would get one millirem per hour equal to 9,000 millirems per year. He said he flew for about 8 hours from Tokyo to Malaysia. He agreed that nobody would sit around the perimeter of the ARE plant all the year around but he retorted that people who lived across the road, were like people who could not choose not to fly, these people were forced to live in the vicinity of the ARE. He said TLD was commonly used in Japan to measure radiation levels for even less than 10 millirems, they were very accurate with the margin of error being less than 5%. He agreed with this mention in D40 about reasonable time for exposure for measurement (D40 being report No. 50 of NCRP). It would depend on cost and logistics. He maintained his measurements were very accurate. He did not want to waste money and he did not also have time. Exposing the TLDs over 3 days was sufficient to get accurate data. On both occasions he came here for doing measurement, he used the same method.

On the second visit in October 1986 (the first visit being in 1984) when he did the measurement the factory had been ordered by the Court to stop operating, and he also found a building standing over the previous dumping site with thick walls made of bricks with a "metal top" with "ventilation gaps" so as to let gases go out. He thought the walls were to prevent gamma rays from coning out, and not the gases. The readings of TLDs placed round the walls were still high but they were reduced by half generally compared with the previous readings. High readings were still recorded because thorium waste was still spread outside the walls just beneath the drain pipes.

The second reason for the still-high radiation levels could be radon gases and thoron gases or their dust were contributing to the high level. He said he had seen some amang factory and that amang emitted radiation usually alpha particles. His readings were of gamma radiation. He had been to a lot of European countries to talk on low level of radiation. He had been to Brookhaven University in America and conducted research with Dr. Sparrow and they found radiation even in small doses would cause mutation. He used to think of nuclear energy as promising but he was now dead against it. He said ARE was not a nuclear power station in the normal sense, but it was not safe for ARE to concentrate all the monazite. To have it underground it might be safe, but not to preserve it in a factory, etc.

He agreed background radiation had existed anywhere, e.g. cosmic rays from the outer space, certain radioactive elements were in concrete and bricks of which houses were built, radiation on the surface of TV sets was very strong, and radon was present in clocks, watches, but the witness said that he should not add more radiation to background radiation. He observed that ARE was a chemical plant which handled materials including radioactive substances. It processed monazite and produced thorium in the process.

One could put thorium in steel drums and could contain it for some years but thorium could decay and the gases could escape. If thorium was kept in container coupled with thick walls it would be quite safe if leak could be prevented. He felt very sad, being a Japanese, looking at the readings, ARE factory was associated with a company in Japan. He agreed medical exposure to X-rays was very common. Radiation in medical science could give a lot of benefits. He came to Ipoh because he was asked by lawyer Meena. Amang factories were not unusual and amang was a name for a group of minerals e.g.. monazite thorium. He said animals were good for study of cancers for humans. He said plant chromosomes and human chromosomes were similar and mutations must be the same for humans and plants.

He agreed with Dr. Radford's evidence earlier that cancer took a long time to form. He had heard of Atomic Energy Licensing Board in Malaysia which gave a tentative licence to ARE and he did not know if ARE was monitored by the Licensing Board. He said it was most difficult and almost impossible to prevent the escape of radioactive gases and the decay of such gases. The radon gas must have come from ARE, it should have come out. One could not stop the production of radon gas. It must have come out from (through) the air. It was very difficult to measure the exposure of human tissues. In Brookhaven, Dr. Sparrow found mutation on DNA, was the same on plants as on mammals and both plant and animal cells had the same radioactive sensitivity. He was referred to his publications. The view of IAEA (International Atomic Energy Agency) accepted the view that low level radiation induced mutation and possibly cancer.

The danger of ARE was that it produced thorium 232 and uranium 236. The products decayed, releasing radioactive materials which produced alpha particles, some gamma rays. The decayed materials produced radon gases and thoron gases. Thoron came from thorium. Thorium had half life of 14 billion years, that was the time it took to reduce its radioactivity by half. Uranium, when it decayed, produced radon 226 and radon 222. Radon emitted alpha particles. There was external hazard because it also emitted gamma rays. Internal exposure was more dangerous. Alpha particles had 10 times more power to affect tissues biologically than gamma rays. Alpha particles could go into the body through breathing, eating or through wound in the body. Any dose was cumulative, alpha particles could attach to dust Radon gases and dust could be carried across the road from ARE to Bukit Merah (plaintiffs' area). More mutations were brought about by internal exposure. When DNA was broken, mutations occurred. If ARE was producing radiation, the internal exposure tended to be higher than external exposure.

Another witness called by the plaintiffs was an electrical chargeman who used to work for ARE and left them in 1986 who described the working of ARE factory from what he saw. It was very dusty with monazite flying about and dust on the floor. He had seen rare earth come out after leaving behind thorium cakes which were splashed on the floor which was wet and dirty. He described the drums for thorium. He described the monazite was taken out of the store and put in a hopper which was then lifted by a fork lift to the 1st floor in a container; then from the container into a larger hopper. From the larger hopper, the monazite was released into the roller mill which would grind the monazite. The roller mill was not enclosed. Monazite escaped from the roller mill, from which the monazite was sucked yet into another hopper. The only reason why he left the job was because he was afraid of getting cancer.

The next witness was an economist, Mr. Martin Khor, holding M.Sc. (Cantab.) and other degrees, a research director of Consumers Association of Penang, who had studied the balance sheet of ARE. He concluded that the company was in serious financial difficulties, being "red" to the tune of RM9,177,759. Looking at job-creating ability of the company, it had invested RM14.76 million, employing 150 workers that is 150 jobs. The ratio was 10 jobs per RM1 million. The national average front the manufacturing sector was 54 jobs per RM1 million that is ARE's job creation was 1/5 of the national average and therefore its contribution in terms of employment, was not significant. Being a very specialized industry, technology transfer was not likely. Since it bought from other countries monazite, it did not generate economic activities with other sectors. The side effect of processing monazite was borne by the people here and the processed goods were exported to other countries.

It was surprising to know, according to the witness that there was very little foreign exchange gained because some of the monazite was imported from Australia and other countries. Some of the machinery and technology were imported, the general manager and service manager were foreign personnel. ARE was owned 35% by Mitsubishi, 35% by Beh Minerals with Tabung Haji being another big shareholder. A foreign company in a joint venture generally gained. The foreign partner would sell machinery at inflated prices, and sell manufactured products to overseas company which the foreign partner in the joint venture had shares in, he said he was not talking about ARE (in particular). There was cost for dealing with toxic waste in terms of health. Witness seemed to draw an analogy from USA where so much was lost in medical bills due to smoking, and loss of productivity due to premature deaths from smoking. The witness spoke of environmental cost, because of toxicity the cost of building a dump site, its maintenance and surveillance; the income loss from the land used as a dump site and land in the surrounding area; the cost incurred after the life span of the containers in the dump, 20 years, 100 or 1000 years, the soil of land could be contaminated. A lot of countries were exporting the toxic waste to Africa, Latin American countries or South East Asia and they found it cheaper to do so.

He said he had been an administrative officer in the Ministry of Finance and an economics lecturer, also a contributor of articles to the magazine called *Utusan Konsumer*. He agreed that tin mining had hurt the environment in Perak and mining was important for economy, and closing of about 500 mines had hit Ipoh. About job creation, the arrival of tractors had reduced manual labour and increased production. He was not aware that ARE was in the process of constructing an excellent modern depository. He was not aware of rare earths consisting of 16 elements, used in computers and electronics; laser for medical and communication purpose; magnets for motors; body scanning machinery and TV systems, and used in X-ray films for reducing radiation exposure. ARE was not a nuclear plant but it was nuclear-related. It was not beneficial to the country, its by-product was toxic and had side effect. Amang was used to produce monazite.

Dr. Jayabalan was recalled by the plaintiffs to give further evidence about conducting further blood tests on a group of 44 children of between 3-12 years of age in Bukit Merah using the lead or lead toxicity as a marker to ARE's waste. Following a similar method of testing, he screened the children to keep out children of parents who were contaminated such as painters, smelters, etc. He sent samples for analysis. He had the report (D54). A level of 20 micrograms per decilitre. The level of a 3-year old was 36, and that of an 11-year old was 38. The toxic levels of

these children were very high. The levels were alarmingly high and the situation very serious. He could see bluish discolouration in the gums and the teeth - clinical sign of lead toxicity; pallor was noticeable and conjunctivitis of children were pale - this could be termed anaemia and this could be caused by interference of lead in haemoglobin production. He advised the parents to send away the children for a while. He collected blood samples from two children who left during school holidays. One was tested in June 1987 and found to have 18 micrograms per decilitre which was described as serious and was found to have reduced level of 11 micrograms per decilitre, in July 1988 and another child, from there was found similarly to have reduced level of 12 micrograms from 18 micrograms. To eliminate one of the sources of lead in drinking water, he took 3 samples of water from Bukit Merah for analysis and the laboratory report found 0.05, 0.02 and 0.03 parts per million. Upon checking with the Ministry of Health, only 2nd and 3rd samples were within safe levels. He also took 2 samples of water from Sungai Serokai, one sample below the drain pipe of ARE and another down stream. The 1st sample was 0.56 part per million, about 11 times higher than the drinking water and the other was 0.50 part per million, the level was close to that of temporary storage facility. He took samples of soils and obtained readings showing nearly as high readings.

In 8 years of medical practice, he had conducted the two tests on lead. Controlled study was not done in this case. Lead was a world-wide health problem. Lead could come from fumes of petrol and from paint. He had eliminated all sources of lead except the petrol. He would not, know if there was lead upstream in Sg. Serokai. He did not compare water from Sg. Serokai with water from Sg. Kinta or other rivers. Most of the houses in Bukit Merah were not painted but whitewashed. In his opinion, the increased lead must have come from ARE's by-products, from its processing ARE that had drainage to Sg. Serokai.

The case for the defence began with Mr. Shidemobu, the general manager of ARE, giving evidence. The ARE plant was at 4¼ miles, Lahat Road, Ipoh. He was appointed in August 1984. He had 16 years' experience as chemical engineer. ARE was established in 1976 and operated in May 1982. Thirty million ringgit was invested in the plant which produced rare earth chloride and rare earth carbonate and the by-product was tricalcium phosphate. From the start-up in 1982 until 1984 the plant operated under the authority of the Ministry of Health and Radioactive Substances Act 1974, authorising the handling of radioactive materials contained in the plant's monazite minerals. He had the manufacturing licence from the Ministry of Trade and Industry. The annual production of rare earth chloride and rare earth carbonate was 400 and 500 tons respectively. With the enactment of Atomic Energy Licensing Act in 1984, and the formation of Atomic Energy Licensing Board, the board carried out its responsibility on radiation protection standard, licensing, inspecting and enforcing. In November 1985, the board formally ordered the plant to stop operating until an operating licence was applied for and obtained. It was applied for on 23 March 1986 and on 13 January 1987 operating licences classes A and G were obtained, temporary class A for handling and class G for storing thorium hydroxide.

Under the licence, his plant resumed operation on 5 February 1987. Amang, he said, was a by-product of tin mining and was separated in tin mining as tailing ores. It contained a mixture of heavy minerals, such as iluminate, zircon, and monazite etc. Thorium was contained in amang. Monazite contained low-level radioactive substance, about 6% of monazite. With the help of a huge chart placed on a wooden stand, the witness explained the process. The monazite was first

ground or crushed at the milling stage, it then was followed by decomposition stage with the use of caustic soda in order to separate the phosphate fraction from the rare earth fraction and thorium fraction. The phosphate fraction that is trisodium phosphate in liquid form and this separated liquid was added with quick lime to become tricalcium phosphate. Trisodium was liquid but tricalcium phosphate was solid, and the latter was then packed in large plastic bags of great strength inside each of which was put another plastic bag which could take 1 or 2 tons.

The remaining fractions *viz.* thorium in a solid state and other fractions that is rare earth in semi-dissolved state then went through further stage where hydrochloric acid was added and the rare earth fraction was dissolved but the thorium fraction remained solid. Thorium fraction in a solid state was separated from rare earth fraction and came out as a by-product, called thorium hydroxide which contained 50% of water and also radioactivity. Radioactive substance was man-made in a nuclear plant whereas the radioactive substance of thorium hydroxide was present naturally in monazite, it was merely separated from it. This plant, he said, was not operating under high pressure and temperature as in a nuclear plant. Explosion could never take place like the one at a nuclear plant in Russia. It was impossible to emit large amount of radioactivity. Monazite contained 6% of thorium. The processed by-product of thorium hydroxide was 12% of the by-product in a form of cakes composed of 50% of water placed in drums stored in a temporary storage facility constructed on a dump site. Finally, these drums would be kept in a long-term storage facility under construction. The drums contained the 2-layer plastic bags and slaked lime was put into the drums such that if acid got inside the cakes would not dissolve, this was a safety feature. On the other hand, tricalcium phosphate which was earlier separated was radiation free and could be used as a fertilizer. Lead was separated in a process so that lead was completely separated. Their company produced two products *viz*. rare earth carbonate and rare chloride, being two sub-fractions of rare earth.

He said they used a "closed negative-pressured" system. Closed system meant that from the time of feeding of monazite until it got out, there was no opening. The negative system meant that when monazite got inside and it could not come out; and therefore monazite dust could not escape into the environs. He explained with his plan again to show that dust could not escape. He had three filters as barriers for the exhaust-air. First the exhaust-air passed through the bag filter from which air was sucked by a pump. The bag filter caught all dust particles, then it went through an additional filter and another filter, the last named being a particles arrester of high efficiency.

He said radioactive materials escaped from the ground, and existed in air. They could be found in building materials, water, foodstuff and even in our bodies. He criticised Dr. Radford for saying that ARE building was "a simple open building" for not having been inside the factory building and Dr. Radford's evidence about the drums being wide open; about the dump site not being properly constructed. They were false. About the radon gas being found by Dr. Bertell around the plant, he said radon gas had been found co-existing with humans since the creation of the earth, it came from the ground, was found in water and from the very building of Ipoh High Court.

About the evidence of the electrical chargeman (PW10), he said PW10 had left his employment because he stole 6 boxes of tiles, the price of which was deducted from his salary. Since 1984,

the Atomic Energy Licensing Board had been inspecting their plant every month, PW10 was not telling the truth. Workers are obliged to wear respirators. The system of his plant completely trapped the dust particles but not radon gas, but the amount of radon gas emitted from his plant was indistinguishable from the level of the Kinta Valley. Effluent from the factory was discharged into Sg. Serokai. The permissible level was 2.7 tons of 10-5 micro-curies per litre that is 2.7 x 10 mc/1. The whole of Sg. Serokai had a level of 1 x 10-5 mc/1, still within the permissible level of the board. There was a certain amount of radioactivity with Sg. Serokai. Their own detailed monitoring concluded their effluent discharge did not add radioactivity to the river. He explained this treatment of radio nuclei or radioactive materials by means of 3 filters. In the first one, caustic soda was added to make the radioactive materials insoluble because of the resulting increased alkalinity level. In the second filter, barium chloride and ammonium sulphate were added to form large amount of precipitated salt which caught the radioactive materials. In the third filter, it was a sand filter.

The final effluent, in a highly alkaline state which was discharged into the Sg. Serokai was neutralized by sulphuric acid. He went on to explain the various measures and instruments adopted for workers' safety, and the workers were safe. They included monitoring equipments such as film badges and dosimeters, rubber gloves, rubber boots, aprons and respirators. The purpose of respirators was to prevent inhalation of dust particles. All levels were found to be within permissible levels set by the Atomic Energy Licensing Board. Under him, there were two officers of the factory who were trained for these measures.

He said further that this temporary storage facility was completed towards the end of November 1986, and it consisted of 4 blocks. It was here that thorium hydroxide which was put in drums were transferred to this site. The drums were steel drums not defective or not without lids. Bad drums were rejected and theirs was a responsible company. He explained with the use of a chart the structure of the temporary facility which was surrounded by a brick wall of 65 c.m. thickness. The floor was made of concrete. There were shielding drums placed on top of the drums containing thorium hydroxide with 3 layers of sand bags. Also outside the warehouse itself, for extra protection there was another thick wall of 65 c.m. thickness. With these measures, no external radiation reached Bukit Merah.

He said that the thorium content was 6% in monazite, but after processing as a by-product, the thorium content was doubled (that is for the same amount of monazite). He produced photocopies of the licences. The site for long-term storage facility was in the Mukim of Belanja because of factors of population, geology and hydrology. The clay-soil was chosen because of no water-permeability and the site should be near to ARE factory. Assessment was conducted of external gamma radiation, concentration of radioactive substances (radio nuclei) in the air, contamination of the soil, river water, underground water by them. After levelling the ground, the long-term facility would be built on it, surrounded by several hills with an area of 100 acres including the exclusive zone which would prevent access to it from the public. The concrete thickness of the wall, floor and roof would be 15 c.m. while inside the concrete building there would be 35 c.m. thick facility. The facility was sufficiently protective of general public and environment. Security guards would be employed. Each section was filled with drums. It would be sealed to cut off air, so that only 2% of the drums surface would be rusted and the oxygen

would be used for causing the 2% rusting. The construction of this long-term facility was nearly completed (the evidence was given on 23 November 1988).

He said to the effect that measurements of radiation were also taken by ARE and he produced the results. The radiation which fluctuated, on an annualized basis was between 100 millirems per year to 330 millirems per year that is (330 mr/py) of Taman Badrishab, Menglembu, Lahat and Bukit Merah regardless of distance from ARE plant. Several points showed higher figures because these points were near amang factory showing 420 mr/py and 140 mr/py as the maximum and minimum respectively. Around the temporary storage site of ARE plant the readings were 530 as the maximum with an average of 270. When he compared results in Kinta Valley and the Bukit Merah, the radiation level of Bukit Merah did not differ very much from the level in Kinta Valley, therefore the radiation from thorium hydroxide did not reach Bukit Merah. The witness in effect disagreed with evidence of Professor Ichikawa,. Dr. Bertell and Dr. Jayabalan. He further described the various uses of rare earth in various industries.

Before he came to ARE in August 1984, thorium was kept underground or site 20m x 30m. This method of burying low-level radioactive material by digging trenches was internationally accepted method with sand of 2 ft. deep covering it. The temporary method was approved by the Ministry of Health before 1984. What some people called ponds were trenches. The white substance as shown in some photographs taken were the tricalcium sulphate which was not radioactive. The witness tested his measuring instrument. Witness then approached the bench of the presiding Judge and measured the radiation and found it to be 400 mr/py.

He said he had no training in the handling of radioactive materials neither was there a radioactivity department in his university where he studied. He did not study it in the university but he did study it. Mitsubishi Chemical Company Co. his employer, could be called a part of the Mitsubishi group of companies. Before coming to Malaysia, there was no study of environment impact and he assumed that the operation was part of the downstream industry of tin mining. Bukit Merah was opposite to Bukit Merah Industrial Area where ARE was situated. Bukit Merah had a school and clinic and was within 1.5 k.m. radius from ARE plant. They used monazite which was separated from amang. Beh Minerals was the supplier of entire monazite to ARE. It was separated from amang in Beh Minerals' factory or purchased it from other sources through Beh Minerals. Beh Minerals was ¼ mile from ARE factory. Monazite which contained thorium - what they did was to collect monazite from all over Malaysia in a centralized manner and to store it safely and ARE was eliminating the source of problem of radioactive by-product of thorium hydroxide. He said ARE's processing resulted in the existence monazite dust, radon gas. Damage to tissue was dependent on the type of radiation and the degree of radiation. If ingested, alpha rays would do more harm than the same amount of gamma rays ingested.

That alpha radiation was 20 times more dangerous than gamma rays was determined after considering various elements. About radon gas, radon gas daughters had existed in natural form in Kinta Valley. Radon gas would go through porous material, could move by gas and water. Half life was 38 days. When half life it changed or disintegrated into radioactive polonium. Wind would carry radon gas, which disintegrated into radon daughters. Radon gas could deposit itself on life tissues, skin, plant and there could be intake, ingestion and inhalation of the gas. ARE's system could not "drop" radon gas, but he insisted that radon gas which ARE could not drop was

indistinguishable from background level. He said he was not denying the emission of radioactive gases from ARE's operation. Such emission was not even a problem in the factory.

He said of the 15,000 tons of monazite, 9 tons came from local sources and 6 tons from outside through Beh Minerals. Tin mining would not go away completely from Malaysia and they could get monazite from outside Malaysia e.g. Thailand, Indonesia, China and Korea. They maintained safety in a centralized manner. It was irrelevant that 40% of monazite came from Australia to ARE. Thorium was twice as much in the by-product of thorium hydroxide than thorium in the monazite but there was no quantitative change. He denied that, by the process in ARE plant, more radioactivity was available for ingestion by human beings and plants, because of release of radon gas making thorium more respirable. The long-term storage site was decided in 1982 to be in Parit, Perak and in 1983, it was transferred to Papan, Perak. He did not know about an MP and a State Assemblyman talking about Parit and there might have been a change in policy of State Government. There was a movement by Papan residents against Papan being chosen. After the report of International Atomic Energy Agency's report made after the protest in Papan, they took immediate action according to the recommendations in the report, *viz*. to cover drums with plastic cover to protect (thorium hydroxide) from rain; to provide shielding for drums by walls and to provide exclusive zone, and to steps leading to the construction of temporary facility, so that the production of rare earth could start. In February 1985, the Atomic Energy Licensing Act and the Atomic Energy Licensing Board were enacted and established respectively. Injunction was served on him on 14 October 1985. Since 1982, permission for operating ARE was given under the Radioactive Substances Act. The Papan site was not selected by ARE but by the State Government. Because of the outcry, ARE had to stop construction of the permanent stage in Papan. Hundred percent of the rare earth product was exported.

He said since 1982, it was necessary for workers to wear respirators, and he disagreed that in 1982, no respirators were bought. About the affluent of ARE, the radioactive substances were radium and uranium.

About the new storage facility, the exclusive zone was 200 metres with no vegetation in it, and there was no pond. Rare earth product was a mixture of rare earth elements of yittrium, lunthanum, terium, and mentioned the names of five others. He was not aware that the biggest producer of monazite in Australia had planned to set up a rare earth plant in New South Wales but later cancelled it. A book co-authored by the witness, entitled "**Rare Earth**" was referred to the witness (P104). Witness read p. 55 which said to the effect that raw material of rare earth, and monazite was more representative of it, included thorium and uranium and about consideration be given for pollution problem and for radioactivity and chemicals.

He said since his university's master's course he had gained experience from supervision of work concerning X-ray machines; had also gained experience about radiation on the job with ARE and also from Professor Kurosawa of University of Waida about the survey of background level of radiation.

Mitsubishi was a minority shareholder of ARE. Before establishing ARE, there was no requirement of assessment of impact on environment. It was important to take safety measures about plant operation; effluent and effect on the environment. It was better for ARE to collect

and centralize the same with control of it and it was a highly technological industry. The Atomic Energy Licensing Board monitored and continued to monitor the operation of ARE, and licences bad been renewed by the board and ARE's workers had been given training. ARE started operating from 1982 until November 1985 when it stopped until February 1987. IAEA of which Malaysia is a member, came to Malaysia and interviewed many people. The witness did not find anything in the report to say that ARE's process was defective, they recommended a temporary site which was constructed. Respirators were bought to give workers protection. Two radiation officers, both possessing B.Sc. respectively had undergone a course and attended a seminar on radiation.

About P104, the book which he coauthored, he said in 1980, there were 17 contributors and he was merely one of them. It was first published in 1962 and he did not then make any contribution to the book. He was not responsible for the contents of the book, and he had no power to alter the contents of the book. About 0.35% of the monazite was lead.

Professor Kurosawa was then called to give evidence for ARE, and he was among other things, professor in science and engineering in Wasede University, Japan, where he was radiation director, and like other expert witnesses called for both sides, he was eminent, had contributed to learned journals and written papers.

Professor Kurosawa said he had conducted monitoring of the ARE plant, and he was requested by ARE to advise them about operating the plant safely, protecting employees, the residents in the vicinity and environment.

He said he had also been requested by the Atomic Energy Licensing Board to conduct his survey in addition to monitoring for ARE. The measurement of radiation of ARE was for the external gamma radiation and concentration of radon and thoron daughters and had visited the plant and the surrounding area 7 times between 8 December 1986 and 3 December 1988 (approximately 56 days in all), during which he gave instruction to the two radiation protection officers of the ARE. He gave detailed evidence about the instruments he used. His measurement (D114) showed the radiation dose rate in Bukit Merah was the same or even lower than other residential areas, and there was not "one piece" of evidence to be found that ARE was imposing some additional radiation to Bukit Merah and therefore ARE's operation was safe and ARE was completely protecting the surrounding, public and residents of Bukit Merah.

Human beings always received background radiation from cosmic rays which accounted for 28 mr/py and also radiation from the ground e.g. the thorium series and the uranium series. There were regional differences with higher level of background radiation level in Kinta Valley. Radon gas was produced from the radium of the uranium series and Kinta Valley had a high concentration of uranium. He was emphatic that ARE's operation had not enhanced at all the background radiation level and around the ARE plant or surrounding area.

He said he was convinced there was no way for radon to be scattered around the plant. There was a memorandum (between him and ARE) for payment of travelling expenses and compensation to him for coming here to take measurements, etc. He was also cross-examined at great length on the measurements. He disagreed that because he had depended on the radiation protection

officers to help in the measuring and the officers were employees of ARE, his study and measurements could not be independent or unbiased. He had found the two radiation protection officers of ARE trustworthy; they did the exchange of the elements of TLDs and sent the TLDs back to Japan to him for evaluation and interpretation. "The employees of ARE did a good job for me."

Dr. Beriell was recalled to give evidence of three persons who had been diagnosed as having leukaemia all within a period of 6 months, two in 1988 and one in 1989. The three children were all born in Bukit Merah. Based on Peninsular Malaysia's average it would be one case of leukaemia for 20 years for 1500 children of age groups of 0-13 years of age. With regard to the three cases diagnosed in Bukit Merah with the number of 1500 children within the same age group, the figure was 42 times higher in Bukit Merah than the Peninsular Malaysia's figure, and 34 times higher if compared with Singapore's figure. According to her calculation, the probability of the leukaemia cases in Bukit Merah happening by chance was less than 1%. White blood cells were the first line of defence against viral infections. The lower count of white blood cells could be caused by radiation. She disagreed that her report about these cases of leukaemia (P136) was a gross exaggeration. She said glue was toxic, did not cause leukaemia but paint had a high risk, and viral infections could cause leukaemia. Smoking could cause cancer. She agreed she was not positive that cancer had come from ARE. She said the high incidence of leukaemia in Bukit Merah was due to the presence of ARE. Compared with lead sulphate, thorium hydroxide, dust and exhaust or radon and thoron gases, smoking would be a trivial causation. She said there were 50 factors for causing leukaemia, but all these 50 factors combined would cause 5% of leukaemia cases and 95% of them would be caused by radiation; this was based on 60 million people followed over 2 years. Cancer would show up from 2 to 30 years. She referred to documents she studied and stated that as to Exh. D140 she said, to the effect, that it was not accurate as it conflicted with various compilers of other reports such as Dr. Stewart etc.

The defence called also Dr. Henry Wagner, professor of medicine and radiology of John Hopkins University, who had studied the use of radiation materials in medicine and biology. Like other expert witnesses he had very impressive past experience and impressive academic qualifications. From a book and article, he mentioned, leukaemia was the 4th most common cancer in Malaysia. He was of the opinion three cases of leukaemia in Bukit Merah mentioned by Dr. Bertell did not show any unusual factor operating other than the usual factors operating and not justifiable to say about the average being 43 times higher, etc. The data should be expressed as so many years, and not an arbitrary period of 6 months. Dr. Wagner referred to various learned journals and articles also to support his opinion. He said radiation caused 1 to 2% of the cancers. The most common cause of leukaemia was unknown. It was unjustifiable scientifically (on the three cases of leukaemia) to generate fear among the people in Bukit Merah, to attribute them to the operation of ARE. It was an idea without facts and the word for it was hypothesis. Hypothesis had been conveyed to mass media as a fact, and for such a situation, the scientists called it a myth. It was unsound to accept Dr. Bertell's hypothesis about the miscarriage. ARE could not have caused them. He had sat in Court throughout the case. It had never been shown that 5,000 millirems per year had given rise to observable cancer.

He said there were aspects of radiation that were extremely beneficial to human beings and a good analogy was fire which was extremely useful from which humans stopped running

thousands of years ago. There was no threshold hypothesis and radiation at a low level could be useful such as ARE plant. About low count of white blood cells, it was because of viral infections and the question was whether the viral infections came from ARE. The experiments of Jayabalan were flawed because there was no control. He said 10% of pregnancies throughout the world resulted in miscarriages and the most common cause was genetic abnormality. Dr. Bertell misinformed Dr. Jayabalan about the cause being radiation for the miscarriages. The study of atomic bomb survivors had gone on for 50 years and no genetic effect was observed. He had seen a lot of motor vehicles in Lahat Road. The problem of lead was widespread and should not be associated with ARE plant. Dr. Jayabalan's finding of 37 mg/dl was alarming but it did not indicate that it had come from ARE, and not justifiable to say it came from ARE. It was scientifically invalid to attribute miscarriages, leukaemia, lead in blood to radiation coming from ARE. He tendered documents to show lung cancer being due to chemicals in tobacco. There was no difference between lower part of the stream and upstream (Sg. Serokia). Blood patterns given were more indicative of infections than radiation.

There were no demonstrable health effect on human beings of radiation doses of less than 10,000 mr/py. The procedure for safe handling of radioactive materials was controlled by Atomic Energy Licensing Board in Malaysia. He explained Dr. Bertell and Dr. Jayabalan did not meet with scientific criteria because measurement of doses was inadequate, the follow-up too short, and number of persons studied too small. Large populations in India and Brazil with 10 times more background radiation had been studied and such study had not revealed any genetic defects on cancers. No data on human beings could demonstrate radiation induced genetic effect. Citizens of Bukit Merah were not being told there was no evidence of mental retardation. A high level of greater than 100,000 mr/py could cause leukaemia. The atomic bomb casualty study was considered by them but it was not essential to his opinion. Chemicals and tar in cigarettes caused cancer and not radiation. He agreed that there was polonium 210 in cigarettes and this element might play a role in causing cancer. The role played by cats in causing cancer was unknown. In causing low count of certain white blood cells, viral infections were common.

He agreed that radiation in high doses caused aplastic anaemia. Every cell contained 50,000 genes located in 23 pairs of chromosomes. Radiation experts had decided to follow the principle of assuming the worst, and as an analogy, if the speed limit was 35 mph it did not mean that if one drove at 45 mph an accident would occur. Witches were burnt at the stake on the basis of hypothesis. Dr. Jayabalan's evidence in essence, was that if he did not know the cause, it must be radiation. One must study radiation's benefits as well as risks. His major conclusion was that the operation of ARE did not represent any hazard to the workers of ARE, citizens of Bukit Merah, any other members of the public or the environment.

The evidence of Dr. Wagner concluded the evidential part of the case.

To keep this judgment as short as reasonably possible, I will try not to discuss any specific parts of evidence of specific witnesses in relation to my findings but will state first my findings on the scientific evidence or otherwise before discussing questions of legal liability or remedies. Such findings will be based on and predicated by the nature of the pleadings and issues contested.

I find and accept on the balance of probabilities or from undisputed evidence as follows (using numbers for the findings as far as it is convenient):

(1) Certain elements in the world are unstable and are called radioactive in that they decay or disintegrate constantly and when they decay, they decay into other elements similarly capable of decaying further, and that in the process of decaying they give off radioactive gases or radioactive rays or radioactive particles or radiation which is their common name. This particular radiation is different from radiation of heat from a fire from firewood or light from an electric light bulb. The radiation from radioactive substances is capable of ionizing atoms. Examples of radioactive elements are thorium and uranium, radon gases, etc.

(2) There are several types of ionizing radiation, such as gamma radiation which can penetrate walls and alpha radiation which can even be blocked by human skin. In such radiation, there are periodical bursts of energy or explosions in the process of ionization in which electrons are removed from the original atoms, electrons being some components of an atom.

(3) I accept that these electrons will combine or interact with water molecules to form highly active chemicals which affect cells of human beings.

(4) Each cell of a human being contains a genetic information base called DNA which advises the cell as to how to reproduce itself.

(5) I find despite the conflict of scientific evidence that cells, or more specifically, the DNA is affected, in other words, I hold there is harmful biological effect on cells from ionizing aspect of radiation of the ionizing type from radioactive substances such as thorium, radium and uranium and the products into which they decay.

(6) I find further that such biological effect is usually of long term in terms of years or decades, and accept that cells undergoing mutation would have to become sufficiently numerous for them to be felt, clinically, for example.

(7) I find more probably than not that such radioactivity damages the cell in either prohibiting, delaying or prolonging the growth of cells including ovum cells and sperm cells.

(8) I accept as more probable than not that such mutations of cells may take years to be felt or seen such as cancer or another generation to show up in the offspring of such congenital defects as mental retardation, etc.

(9) I find that the monazite contains 6% of thorium and thorium is radioactive and such thorium is doubled after monazite is processed by the ARE. I also find on a balance of probabilities monazite contains though considerably less than thorium, portions of uranium and radium also radioactive elements.

(10) I find that the by-products of the processing of monazite by ARE are thorium hydroxide which is radioactive and also lead.

(11) I find that when thorium decays, it produces *inter alia*, thoron gas (radon 220) and with uranium, it is radon gas (radon 222) *inter alia*.

(12) I find that thorium, radon and thoron and the products into which they decay all give off radiations usually of the alpha or gamma types. Alpha radiation, though it can be blocked by skin, can be absorbed into human body by breathing, eating or through open wounds; and I find also that alpha radiations have 20 times more energy than gamma radiation, in terms of such energy being released causing harmful biological effect on DNA of human cells of which human tissues are composed.

(13) I find and accept as more probable despite the conflict of scientific evidence that there is no threshold dose of radiation for such biological effect on cells; that absorption of radiation is cumulative or accumulative and that even a very small dose of it has its impact.

(14) I find and accept that thorium has a life of 14 billion years.

(15) I find that since time immemorial on the creation of the earth, radiation (of ionizing type) has been found naturally on earth, in the form of cosmic rays from above, escape from underground on the earth's surface.

(16) I accept that such natural radiation is called background radiation present anywhere in the world, and more probably of a higher level in places like Kinta Valley in which city of Ipoh is situated.

(17) I accept and find more probably than not that radiation level in such background radiation can be enhanced by commercial activities of man.

(18) I find and accept that from rocks which contain radioactive elements, if they are compacted or not broken, release of radioactive gases is minimized, and enhanced if they are broken, crushed or milled.

(19) I find more probably than not, that plant cells have the same sensitivity to radioactivity as human cells and that results of studies of plant cells as regards such sensitivity can be transposed to human cells but I find it more probable than not, as a scientific fact that low levels of radiation can have harmful biological effect on human cells from or as indicated by studies of plant cells and also from the earlier finding that there is no threshold dosage which can trigger off such mutations or biological effect on human cells.

(20) I find that the legal limit for exposure to radiation is 100 millirems per year (100 mr/py) for general public as fixed by ICRP that is International Commission for Radiological Protection.

(21) I find that though the experiments of Dr. Jayabalan as regards the presence of lead were not carried out in accordance with the usual criteria of the scientific community especially in the absence of a proper "control" as explained in evidence, nonetheless the findings do indicate a substantially higher level of lead among the children from Bukit Merah who were tested, after taking a significant account of possibility of inaccuracy in regard to the figures of lead levels.

(22) I find that lead was acceptable as a tracer to the existence of radioactivity found in Bukit Merah though by no means conclusive but it could be considered together with other evidence.

(23) I find that the operation of ARE was authorised by a licence earlier issued under Radioactive Substances Act 1968 which was replaced by Atomic Energy Licencing Act 1984, and under the latter Act, licences for handling and storing radioactive substances continued to be issued and renewed to this day.

I will now deal with further findings (it will not be convenient to number them) which are more germane to the matters in issue in this case so that elaboration and explanation will be necessary; the first of these matters is that measurement of the radioactivity that is radioactive rays and gases.

I have mentioned the readings of measurement conducted by Dr. Bertell and Professor Ichikawa. This measurement registered very high readings around the ARE plant and land or compound. In the absence of any contrary evidence, no one could fail to be convinced that the operation of ARE was producing a great deal of radioactivity, and such radioactivity cannot but add on to or enhance the background radiation already existing before the commencement of the operation.

On the other hand, the readings recorded by Professor Kurosawa's measurement and ARE's own measurements point to the opposite direction and show that the operation of ARE has in fact not enhanced the background radiation.

The expert witnesses are very eminent with a great number of academic qualifications, learned papers and experience to their credit. Either the measurements of plaintiffs' experts or ARE's expert are wrong or inaccurate.

As far as their demeanour while giving evidence in Court is concerned, by comparison, Professor Ichikawa and Dr. Bertell appeared to be much more earnest, sincere and nay, almost alarmist. On the other hand, about Professor Kurosawa, one could not help noticing and feeling his sleekness and that indefinable smugness in his evidence. Professor Kurosawa looked much more like a very well-dressed smiling top business executive than an academic, bearing in mind at the same time that a book should not be Judged by its cover, and considering his impressive credentials. I do think my view about him ought to be cut and dried at this juncture by saying straightaway that he was not telling the truth, though in the past I was not spared a somewhat similar situation of two surgeons in Court mentioning two distinctly irreconcilably different measurements of the shortness of one leg of an accident victim, for example.

The measurements by Professor Ichikawa covered a period of three days and those of Dr. Bertell, one day while on the other hand, the monitoring by Professor Kurosawa covered a very long period indeed, from 1985 to 24 March 1989. When he gave evidence, other things being equal, the reliability of measurements of Professor Kurosawa is far greater, unfortunately other things are not so equal, not just the question of demeanour mentioned above.

The two radiation protection officers employed by ARE have actively and materially assisted Professor Kurosawa. The professor taught them how to change the TLDs which had to be

changed once in three months, and CN films inside the TLDs which had to be changed once in two months. Such changing was done almost entirely by these two ARE's employees except for these periods Professor Kurosawa was down here from Japan himself where he could have most probably changed them himself when changes were due. The professor taught them where to place the TLDs at the designated places.

These officers both with degrees of B.Sc. who were taught by Professor Kurosawa sent the TLDs to him in Japan with the necessary notes, on TLDs readings, on which Professor Kurosawa must have compiled his reports. He said repeatedly he trusted them but the danger of manipulations of TLDs and their readings and making tendentious notes on such readings for sending them to Professor Kurosawa in Japan must have been very great while DW1, Mr. Shidemobu, the general manager of ARE who gave evidence so strongly in favour of ARE must have been a person in authority as regards these two employees whose will DW1 must have been able to dominate to a significant extent.

Further, according to Mr. Shidemobu, who explained the system of processing the monazite in his plant, said his system could not trap radon gas produced by the unstable thorium. Thorium was 6% - 7% of the content of monazite and the content of thorium was doubled as a by-product. Despite the system of processing monazite, he said the system could not trap radon gas which therefore must have escaped from ARE plant to area including the air space near the boundary of ARE and its vicinity which has to include Bukit Merah across the metalled road. He in fact said he did not deny the emitting of radioactive gases. He said the annual production of the rare earth from ARE was 900 tons. One could picture the sizeable amount of thorium and the consequential radon gases. In this connection, DW1 said to the effect that ARE was doing a good turn (for Malaysia) because so much monazite was centralized of collected at ARE premises, but he must remember that not all the people of Malaysia throughout the length and breath of Malaysia have objected to it but only the neighbours in the neighbourhood of ARE that is the plaintiffs.

Bearing these statistics in mind, when one considers the readings of Professor Kurosawa, the readings around ARE were the same as compared with those at Bukit Merah and further away, Taman Badrishah, etc., the readings do not seem to make sense. They show that they have been manipulated more probably than not, as Professor Kurosawa must have been misled by these two employees of ARE that is the radiation protection officers who would have every opportunity to tamper with the TLDs and their readings before sending them to Professor Kurosawa in Japan who had earlier taught them how to operate and read them.

Again DW2 said radon gas, when explaining the background radiation, came from ground even if the ground was clay, though more slowly. The concentration of radon in open pit mines was 200 times of that at Bukit Merah. If there were many times' concentration of radon in such mines, how many times' concentration of radon would there be at the factory for the production of thorium hydroxide as a by-product from which the radon gas escape and cannot be trapped and therefore escape to ARE's neighbourhood. Where else can radon disappear to if thorium has a life of 14 billion years, and the decayed products would go on being produced forever. The readings of DW2 ought not to be allowed to stand defying as they do, even common sense.

My finding therefore is between the evidence of measurements given by Dr. Bertell and Professor Ichikawa on the one hand and that of Professor Kurosawa on the other hand the evidence of Dr. Bertell and Professor Ichikawa is more probable on a balance of probabilities.

It is my further finding that radon gases (namely radon 222, a product into which uranium decays and radon 220, also known as thoron, a product which thorium decays into) escape into the air from ARE plant; and that thorium and uranium, are contained in monazite. Further the system of manufacturing the rare earth fails to trap any of these radioactive radon gases.

It is my further finding that one of the radioactive materials in the monazite that is thorium increases by about 100% upon separation by the chemical process of the ARE and that all the radioactive materials give off radiations which are ionizing radiations involving the removal of the electrons from atoms.

It is my further finding on a balance of probabilities from the survey of absorption and ingestion of lead by the children of residents of Bukit Merah (selected to avoid some factors that could have contributed to the increase of lead in the surroundings of Bukit Merah) that there was more probably a higher level of lead in Bukit Merah than that of the national average after taking account of the usual factors such as paint etc. The lead used as a tracer for radiation could be so used, though it is no means conclusive and can be just taken into consideration in an overview of evidence.

Should my findings about the evidence of measurements of radiation not be accepted, there are two things that I ought to emphasize. The first is radioactive radon gases and radiation in connection therewith cannot be trapped by the closed system that DW1 said was employed despite the utmost care said to be taken, no doubt partly due to their inherent tendency to escape (e.g. gamma radiation's ability to even penetrate a wall, *inter alia*). Secondly such a vastly increased quantity of so many tons of monazite has been continuously brought to the ARE plant for processing for producing 900 tons of the rare earth annually and therefore concentrated in ARE factory near the plaintiffs' houses, and the amount of radioactive substance that is thorium contained in monazite has been doubling on account of monazite being processed. Both these facts were admitted by DW1. ARE plant is situated in the midst of a very densely populated area in the city of Ipoh, notably, comprising not only Bukit Merah, but also Menglembu; and the old town section in which are situated the administrative and the financial centres of city of Ipoh. Both the two facts and the location of the ARE plant are sufficient in my judgment to merit the injunctions asked for by the plaintiffs without the necessity to resort to the evidence of measurement of radiation from Dr. Bertell and Professor Ichikawa and also to the evidence of increased level of lead used as a tracer for radiation, all such evidence being merely supplementary.

In the same vein, perhaps, if the ARE plant had been situated in an isolated and desolate area and its operation had been conducted or housed in a building built as nearly alike as possible as the permanent storage building or facility constructed in the Mukim of Belanja with necessary modifications, it would be able to play its role of producing commercially and profitably rare earth. I have set out above a brief extract of evidence concerning the fortress-like structure of the permanent storage facility of ARE at Mukim of Belanja.

In view of all the findings set out above, I conclude that radon gases and all other radioactive materials are dangerous things.

I now deal specifically with the basis of the claims of the plaintiffs one by one. First, they base their claims on negligence, particulars of which are set out in the statement of claims.

I find that ARE started operating in May 1982 until November 1985. ARE resumed operating on 5 February 1987. Between May 1982 and November 1985 I find the waste of the ARE's processing including thorium hydroxide, was not stored or kept away in a sufficiently safe manner, in that some waste was kept in open air, in drums, some of which were rotten, in trenches which were too shallow.

I find further that due to the lack of evidence from the plaintiffs and the expert witnesses (understandably they were not allowed to inspect inside the ARE plant), and from the evidence of DW1, the general manager of ARE, the plaintiffs have failed to prove on a balance of probabilities that the defendants have not exercised a sufficient amount of care towards the plaintiffs in regard to the operation of ARE **after** 5 February 1987.

The claim, in so as it is based on negligence, ought to succeed partly *viz*. at least in regard the period between May 1982 and November 1985, but this is not to be so.

However, there is not evidence of actual loss or damage or personal injuries which are directly due to the negligence found against the ARE before November 1985. It is well known that negligence alone does not give a cause of action unless actual damage co-exists with negligence, see the *dictum* of Viscount Simon LC in *Suffolk River Catchment Board v. Kent* [1941] AC 74 at p. 86. The claim based on negligence is dismissed.

I now turn to the claim based on the rule in *Rylands v. Fletcher*. The rule, born out of the species of nuisance, but with an independent life of its own since the case bearing the same name as the rule in 1868, is stated thus:

The true rule of law is, that the person who for his own purposes brings on his lands and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril, and, if he does not do so, is *prima facie* answerable for all the damage which is the natural consequence of its escape.

I will now deal very briefly also on this claim under *Rylands v. Fletcher*.

The essence of the rule lies in dangerous things being brought on to the land and was called the "wild east" theory by a learned Judge in the last century. Such things are either inherently dangerous such as fire, gas and electricity or according to Lord Porter in *Read v. Lyons* [1947] AC 156 at p. 176, things (which are not inherently dangerous) are dangerous having regard the circumstances at the time and place and the practice of mankind.

The liability of person who has management or control over such dangerous things is owed to the world, in other words to anybody who is affected by the escaping dangerous things.

The radon gases which are dangerous to health do escape from ARE's plant and monazite has been brought, collected and kept there at the ARE's premises for processing. One would have thought that the facts do come squarely within the rule of *Rylands v. Fletcher*. However no actual damage has been proved.

Claims based on *Rylands v. Fletcher,* like a lot of other torts such as negligence, cannot be maintained when damage has not been suffered. Damage is essential to complete the cause of action under *Rylands v. Fletcher* as in negligence.

Actual damage has not been proved, for what has been proved is a high probability that very serious injuries will be caused to the plaintiffs and other residents of Bukit Merah, but such injuries will only be palpable and visible to the doctors in the future. The injuries are not imminent, in the ordinary sense of the word, but the magnitude of such injuries involving possibly a large number of people is mind-boggling.

It is settled law, however, that injunction and damages are but two forms of remedies for the same wrong and facts which entitle a plaintiff to injunction must be necessarily also entitle the plaintiff to claim damages, thus if there is no actual damage proved, no injunction will issue. Please see the *dictum* of Lord Watson in *White v. Mellin* [1845] AC 154 at p. 187. However, plaintiffs are asking for a *quia timet* injunction which is an exception to the rule aforesaid. An action can be filed and will be entertained by the Court for this type of injunction before actual damage has happened, that is, before a complete cause of action is completed. All that is required is that there should be some practical certainty of substantial damage and that it is imminent. Please see *Earl of Ripon v. Hobart* [1834] 3 My. & K. 169 at p. 176. Speaking of the element of imminence, Brougham LC said in that it could be less imminent, and to quote:

According to the same practical and rational view, and balancing the evidence against the chances of its occurrence, it will even provide against a somewhat less imminent probability in cases where the mischief, should it be done (would be) vast and overwhelming.

In *Hooper v. Roger* [1975] Ch D 43, when a sharp slope together with a house on its top of land was in danger of collapsing at some future date because of defendant cutting across at or near the base of the slope. Plaintiffs' surveyor called it a long-term danger. It was considered imminent enough for the purpose of granting a similar injunction. I feel able to distil from the authorities that as regards damage the word "imminent" is not in law understood in the sense as understood in common parlance. Thus where it may even take years for actual damage to occur, it does not bar the issue of such *quia timet* injunction when the damage is either of great magnitude or irreparable. Plaintiffs should therefore be entitled to the *quia timet* injunction asked for as a good number of people would be affected and the biological damage to human cells irreparable and I shall state the terms of it at the end of this judgment.

I now deal with the claim of the plaintiffs based on a private nuisance. It must be apparent to everyone that this claim is based on that kind of nuisance not of causing physical damage or encroachment to one's neighbours' land but which is concerned with the unreasonable interfering with one's neighbours in the comfortable and convenient enjoyment of the said neighbours' land. To be actionable it must be a real interference with the comfort and convenience of living

according to the standards of average man, thus to name a few from numerous cases, nuisance such as stenches from offensive trade from stables (*Rapier v. London Tramways* [1893] 2 Ch 588), smoke and noxious fumes (*Crump v. Lambert* [1807] LR 3 Eq 409, *St. Helans Smelting Co. v. Topping* [1805] 11 HLC 642), noises from banging of lift door (*Newman v. Real Estate Debenture Co*. [1940] 1 All ER 131). In a nuisance of the kind described above and involved in the present case, proof of actual damage, physical or financial or personal injury is not required, the law presumes damage here just as in the case of private nuisance by encroachment so long as the encroachment is proved. Thus in the nuisance of the kind in question here, injury to health need not be proved (*Crump v. Lambert* (*supra*)) once annoyance or discomfort is established, just as once encroachment is established in the other kind of private nuisance just mentioned.

It is settled that negligence is not an essential element in nuisance; see *dictum* of Lord Reid in *Wagon Mound No. 2* [1967] 1 AC 643 at p. 639; see *Read v. Lyons, supra*. Thus an occupier may exercise the utmost care in using the premises, yet he may be liable in nuisance for emission of noxious fumes or nuisance which is of a substantial degree. For in nuisance generally speaking, once it is proved a defendant can justify it by any one of the well-known defences. In ascertaining the question of substantive degree of annoyance or discomfort, competing rights of both sides must be balanced and considered, in a spirit of "give and take, live and let live' (*Barnford v. Turnley* [1862] 3 B & S 62 at p. 83). In the case of nuisance of the kind involved here, the situation complained of ought to be something over and above the inconvenience normally existing in the locality where a plaintiff and defendant both reside. There must be a substantial interference with enjoyment of land. Nuisance is basically an invasion of rights in the enjoyment of land unlike basically the question of conduct of a plaintiff which is in issue in an action for negligence.

It is necessary to point out that an occupier of land can sue, and the plaintiffs are such occupiers and residents of land in Bukit Merah. This has never been disputed.

It is also further pertinent to point out that cases of nuisance are more amenable to and concerned with the remedy of injunction than with other torts such as negligence. This must have prompted Lord Denning to say in *Miller v. Jackson* [1977] QB 966, 980 about the books being full of cases of injunctions having been granted to restrain the continuance of a nuisance, and "but there is no case so far as I know when it has been granted to stop a man being negligent".

I now come to the moment of truth in regard to ARE having regard to the findings and brief discussions above about the balancing of competent interests of ARE and the plaintiffs, the residents of Bukit Merah.

The radon gases that escape inevitably from the operation of ARE in its simple and open factory building do enhance the background radiation. I have found and accepted the evidence of measurements of Dr. Bertell and Professor Ichikawa as the more probable on a balance of probabilities for reasons already explained. In my opinion, such radioactive radon gases are extremely dangerous to health and would cause very serious injuries in the long term. The gases thus cumulatively are damaging the DNA in the cells of human beings in Bukit Merah, it being so near to ARE. They contribute a very substantial interference with the comfort of the plaintiffs in the enjoyment of the land and they reasonably constitute an annoyance to them. Damage is

presumed by law once this nuisance is established that is with regard to the substantial interference with enjoyment of their land, *viz.* their health is being affected harmfully, insidiously, significantly or to substantial degree. Once damage can be presumed on proof of such annoyance or discomfort of the plaintiffs in their enjoyment of their land, an injunction may be suitably considered though no pecuniary compensation may be awarded.

The operators of ARE knew and in fact must have known that the operation of processing monazite would produce the enhanced amount of radioactive substances including the radon gases, and whilst utmost care is taken it is of no avail to them so long as the consequences of their operation extend to the plaintiffs' land.

I have not lost sight of the fact that the ARE plant has been situated in an expressly industrial area close to where Bukit Merah is situated, and therefore the question of character of neighbourhood is very relevant. However the emission of radioactive substances to the already existing background radiation and the dangerous nature of the resulting radiation are things over and above the inconvenience which the plaintiffs as the residents in the immediate vicinity of the expressly industrial estate in which the ARE plant is situated would otherwise to be asked normally to accept despite the large sum of money which the industrial or financial giants have invested; despite the jobs that have been created by ARE; inspite of the very useful applications of the rare earth in industry. On balancing the interests of ARE and those of the plaintiffs and other residents whom they represent, the interests weigh heavily in favour of the plaintiffs so that it would be idle to tell them "to live and let live" in regard to the ARE plant.

ARE has contented that it is licensed to handle and store radioactive substances by virtue of licences issued under the Atomic Energy Licensing Act 1984.

No licence issued to ARE can amount to a licence to ARE at the same time to commit any tort against anybody. It brings to mind immediately that mining companies which have been ordered to pay damages for nuisance and e.g. under the rule in *Rylands v. Fletcher* even though these companies could be safely presumed to have permits to mine or mining licenses issued under Mining Enactment, for example, see *Hooi Wee Thim v. Pacific Tin Consolidated Corp.* [1966] 2 MLJ 240. These miners would not have been entitled to say that they had licence to cause floods etc. to neighbours.

Further, it is the very nature of the type of nuisance involved herein that the acts of the defendants are lawful, e.g. a licensed factory gives off smoke through its chimneys; nuisance is caused when the consequences of such lawful acts are not confined to a defendant's land but extend to neighbouring land of a plaintiff. The contention of ARE on this point can therefore be dismissed without a second glance.

I must immediately point out that cases of private citizens (or corporate citizens for that matter) must be immediately distinguished from public authorities, local authorities, and other statutory agencies which act under legislative authority but not just under mere licence, such as the former Central Electricity Board, City Council of Ipoh, Water Authorities of State Governments. ARE is not one of these bodies mentioned; and should not be confused with them. Liability for committing nuisance or under the rule in *Rylands v. Fletcher* etc. may be excluded by legislative

authority. Should it be argued elsewhere that such a private citizen could simulate such a public body for the purpose of exemption of liability for such citizen by virtue of licence issued to him as compared with such body acting under any Act of Parliament or other statutory enactment, I think I had better set out my further views thereon though I find such simulation or comparison odious.

In connection with a claim against such a public or statutory body, whether it is liable or not in nuisance or under *Rylands v. Fletcher*, depends on whether such a claim is excluded by the statute or the Act of Parliament under which it acts, and very often the very statute in question has given birth to the body. Such exclusion is a matter of construction of a statute in question. It may be express or it may be implied.

It is implied when the body is under a statutory duty or a statutory obligation to do the act complained of. Thus in *Green v. Chelsea Waterworks Co.* [1894] 70 LT 547, a main of the defendant burst without negligence and flooded the plaintiff s premises. The defendant was under a statutory duty to maintain a continuous supply of water and that such damage would be caused by occasional bursts, it was held by necessary implication, the statute had exempted them from liability when there was also no negligence. The ratio was applied by the House of Lords in *Longhurst v. Metropolitan Water Board* [1948] 2 All ER 834.

Such exclusion cannot be implied if the statutory legislation merely gives permission and does not impose a mandatory authority or statutory duty, see *Charing Cross Electricity Co. v. Hydraulic Power Co.* [1914] 3 KB 772.

The above cases draw the line so clearly but they were decided under *Rylands v. Fletcher* and the question arises if they also apply to nuisance. In my view, they do. First, as nuisance is the progenitor of *Rylands v. Fletcher*, there are similarities. Very often a claim succeeds under either or both of them. In more senses than one, a claim under *Rylands v. Fletcher* is an aggravated form of private nuisance. If liability under *Rylands v. Fletcher* can be excluded by a statute expressly or by implication, a *fortiori* it can be so excluded in respect of liability in nuisance. The case cited above have the advantage of clarity.

A perusal of the Atomic Energy Licensing Act 1984 reveals, *inter alia*, the licensing and control of processing and disposing of radioactive material; health and safety measures for protection of workers and public, etc. and powers of arrest, seizure and prosecution.

If ARE simulates a public body, the Atomic Energy Licensing Act merely grants permission and does not impose or charge ARE with a statutory duty to manufacture the rare earth commercially. Further, if permission is granted, ARE could have in any event located the plant and store at a desolate place well away from any densely populated area.

Before departing from the case, I must thank all Counsel in this case for all the assistance they have rendered me especially for their patience with the time taken by me, especially to Dato' P.S. Gill then leading Counsel for the defendant (now Mr. Justice Gill) who has very kindly annexed to his written submission a very useful glossary of scientific terms and who has done so much for

the defendant in this case that it has become my unpleasant duty to find against the defendant in this case.

I therefore give judgment for the plaintiffs and make the following orders:

(1) A declaration that the defendant is not entitled to operate its factory and keep its toxic and radioactive waste upon its land at Bukit Merah Industrial Estate, Jalan Lahat, City of Ipoh, State of Perak;

(2) that an injunction restraining the defendant, by itself, its servants or agents or otherwise from operating its factory, producing, storing, and keeping its toxic and radioactive waste upon its said land in the City of Ipoh. These activities are hereby held to cause the escape of radioactive gases and rays into its neighbouring land occupied by the plaintiffs;

(3) that a further mandatory injunction be granted that the defendant do remove all the toxic waste and radioactive waste as soon as possible to its permanent storage facility at Mukim of Belanja, State of Perak (which the defendant has built and completed) strictly in accordance and compliance with all the conditions imposed on it by the Atomic Energy Licensing Board, Malaysia;

(4) that a stay of execution of the above injunctions be granted to the defendant for 14 days from today to enable it to take all necessary steps preparatory to its immediate compliance with the injunctions 14 days from today; and

(5) that leave be granted to apply generally and costs be paid to the plaintiffs.

Also found at [1992] 4 CLJ 2299